

SHORT COMMUNICATION

***METOPIA SINENSIS* (DIPTERA, SARCOPHAGIDAE), AN UNUSUAL PREDATOR OF *LIPHISTIUS* (ARANEAE, MESOTHELAE) IN NORTHERN THAILAND**

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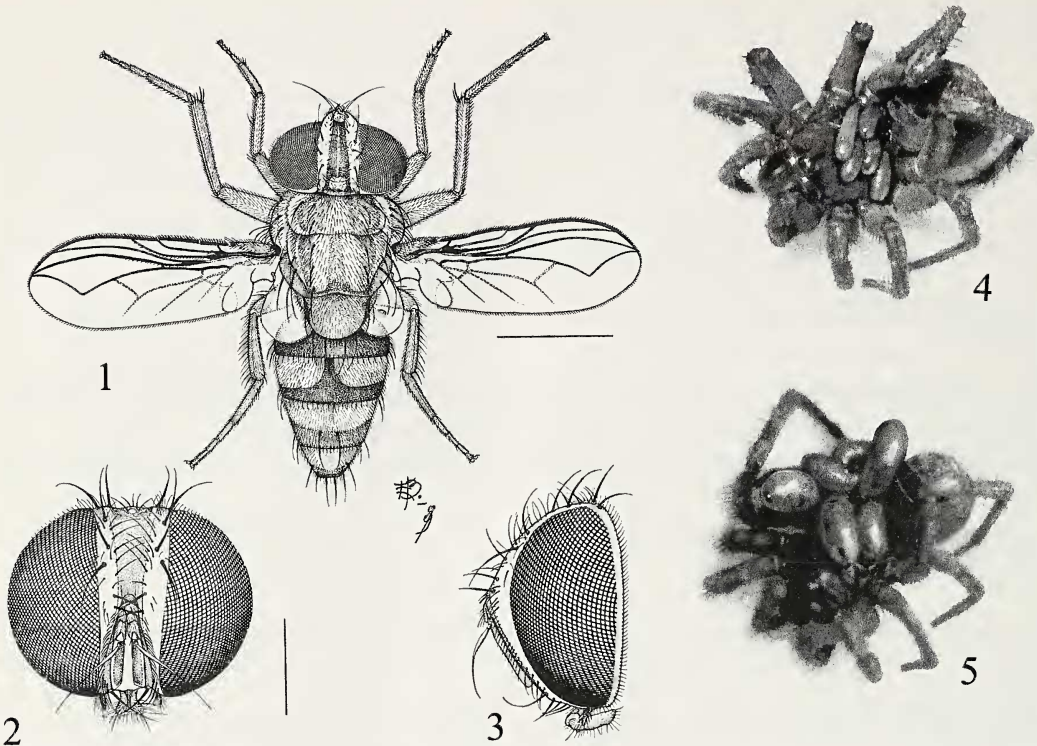
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Knowledge on predators, parasites and parasitoids of the Mesothelae is sparse and fragmentary. Various authors reported on gamasid and erythraeid mites, mermithid nematodes and *Rickettsia* infesting either adult mesothelid spiders or their egg cases (Bristowe 1933; Yoshikura 1954; Platnick & Sedgwick 1984; Haupt 1979 & pers. comm.). Sedgwick & Platnick (1987) found a wasp pupa in an abandoned burrow of *L. endau* Sedgwick & Platnick 1987 in Malaysia, and Bristowe (1976) reported the observation of an unidentified pompilid wasp larva attached to the abdomen of a paralysed *L. desultor* Schiödt 1849 found inside its burrow on Penang Island, Malaysia. The latter author further mentioned empty pupal cases of a fly among the old fragments of *L. bristowei* Platnick & Sedgwick 1984 (misidentified as *L. birmanicus* Thorell 1897) in Thailand, probably on Doi Suthep (Mount Suthep), Chiang Mai, northern Thailand (cf. Bristowe 1975). Recently one of us (PJS) found puparia and imagines of *Milichia* sp. (Diptera, Milichiidae, det. by J. Chainey, The Natural History Museum, London) among partly devoured eggs of *L. yamasakii* Ono 1988 in northern Thailand. Also puparia of another cyclorrhaphan fly were collected from several empty burrows of *L. bristowei* on Doi Suthep and nearby Doi Inthanon, but no imagines could be obtained for a proper identification (Schwendinger 1990). Later Schwendinger (1998) reported a second, more

fortunate find. Imagines of *Metopia sinensis* Pape 1986 (Figs. 1–3; specimens deposited at the Swedish Museum of Natural History, Stockholm), a miltogrammine flesh fly, were raised from larvae infesting three or four carcasses of *L. lahu* Schwendinger 1998 inside the spider burrows at Doi Angkhang, about 150 km north of Doi Suthep. The fly species was at that time known only from a single specimen from southern China (Pape 1986a, 1996). The observation was cautiously interpreted as a case of carrion feeding rather than predation or parasitism (Schwendinger 1998) because species of *Metopia* Meigen 1803 are known to be kleptoparasites in nests of solitary aculeate Hymenoptera (Pape 1986b, 1987; Spofford et al. 1989). The fly larvae feed on prey stored for the host progeny. New observations reported and discussed in the following, however, indicate that *M. sinensis* very likely is a primary predator.

In December 1997 PJS again found fly puparia of *M. sinensis* in two empty *Liphistius* burrows (near the Thai-Myanmar border in Mae Hong Son Province, northern Thailand) in a colony of an undescribed species closely related to *L. lahu*. All puparia had already hatched; but one of the spiders collected, a lively and seemingly healthy female with a new egg case, carried six tiny fly larvae ventrally between its leg coxae. The next day (after transferring the spider to a laboratory in Chiang Mai) the spider was found motionless



Figures 1–5.—*Metopia sinensis*. 1. Male, habitus, dorsal view; 2. Male, frontal view of head; 3. Male, left lateral view of head. Note very large eyes, taking up almost entire side of head, and strongly-receding head profile with numerous facial bristles along the antenna. 4. Larvae of *Metopia sinensis* feeding on a dying *Liphistius* sp. female, second day after collecting; 5. Same, on third day after collecting. Scales: 1 = 2.0 mm; 2, 3 = 0.8 mm.

and apparently dying, and by evening the larvae had moved onto the posterior part of its carapace (Fig. 4). On the fourth day the fully grown larvae (Fig. 5) abandoned the dead spider after having devoured most of the tissues inside the prosoma and anterior opisthosoma. On the fifth day all larvae pupariated, four directly on the spider carcass, the remaining two in the container, a short distance away from the spider. Seventeen days later five imagines hatched, the sixth in the morning of the 18th day. The two male and four female flies were kept alive for two more days, during which they behaved quite atypically for sarcophagid flies: flying clumsily and unwillingly, most of the time hiding among the substrate. This may, however, be an aberrant behavior due to unnatural conditions in the laboratory. A search for *M. sinensis* at the same locality during two days in December 1998 was unsuccessful. All spiders examined were unaffected, no puparia were found and no adult flies were

attracted to three live *Liphistius* females (deposited in the Natural History Museum of Geneva) dug out of their burrows and placed as bait in uncovered containers.

Species of *Metopia* are known to be kleptoparasites in nests of various aculeate wasps and bees of the families Pompilidae, Sphecidae and Halictidae (very rarely also Vespidae), and the particular fly species seem to have a broad spectrum of hosts (Spofford et al. 1989). The flies have been classified as “hole-searchers” (e.g., Evans 1970; Spofford & Kurczewski 1990), which means that females search for host nest entrances rather than trail the wasps themselves. The female flies may larviposit into the host burrow, either standing on the rim or flying low over the hole, and the larvae then wriggle down to the stored prey of the wasp. Or, the flies may enter the burrow to larviposit near or even onto the food source. The odor of the wasp presumably triggers gravid flies to larviposit after they

have located the entrance of a host burrow (Endo 1980a,b). Being "hole-searchers," species of *Metopia* pay only little attention to prey specimens that are dragged or otherwise transported by a potential host wasp. However, individual wasps dragging prey close to the nest, and even more so those excavating burrows, may be attractive to female *Metopia*. The prey itself is not used as substrate for larviposition before it is deposited in the burrow, but female flies may occasionally larviposit directly onto the adult wasp. The latter apparently always turns out to be fatal for the fly larvae (Endo 1980a).

The present observations are considered unambiguous evidence that the association between *M. sinensis* and *Liphistius* spp. is not simple carrion-feeding. The possibility that the *Metopia* larvae were deposited on a spider left insufficiently paralyzed by a pompilid wasp is not considered very likely as the infested spider appeared in full vigor. Also, the repeated finds of flesh-fly puparia, here tentatively attributed to *M. sinensis*, in *Liphistius* burrows show that the association is persistent in time and not just a haphazard or freak larviposition. Note that the find of fly puparia by Bristowe (1976) may also refer to *Metopia sinensis*. We have decided to classify *M. sinensis* as a predator rather than a parasite (or parasitoid), following Price's (1980) definition, which states that a parasite is primarily "an organism living in or on another living organism." As the larvae of *M. sinensis* apparently kill the spider and complete most of their larval life on the carcass, they behave more like predators, even if grossly outsized by their prey.

The predator-prey association between *Metopia sinensis* and *Liphistius* most likely developed from kleptoparasitism. Sparse information from the literature and observations in Thailand by PJS indicate that pompilid wasps attack and paralyze *Liphistius* directly inside the spider burrows. In the case of *M. sinensis*, however, it appears that the wasps have completely lost their role as food providers for the fly larvae.

Predation appears to be rare or local and, at least in northern Thailand, confined to only a few *Liphistius* species. Other *Liphistius* species in the same area (i.e., *L. yamasakii* and *L. lannaianus* Schwendinger 1990) and species elsewhere in Thailand were repeatedly

observed and collected in moderate numbers by PJS during more than seven years, yet none of them was ever seen affected by *M. sinensis*. In this context, it is interesting that the infested burrows of *L. lahu* at Doi Angkhang were only about 2 km away from a thriving population of *L. lannaianus*. On Doi Inthanon, fly puparia (presumably of *M. sinensis*) were collected from scattered burrows of *L. bristowei* at 1250 m, but not found in the dense colonies of *L. yamasakii* 350–530 m higher up. From the same mountain, at 1000 m, 11 flies were also raised from the carcass of a mygalomorph spider, *Damarchus* sp. (Nemesiidae), found inside its burrow. The flies were identified as *Metopia* sp. by Nigel Wyatt (The Natural History Museum, London) and possibly also belong to *M. sinensis* (specimens unfortunately lost after identification).

While local prey specificity cannot be ruled out, a broader prey spectrum seems very likely considering the known distributional range of *M. sinensis*, which is much larger than that of its known prey. *Liphistius bristowei*, *L. lahu* and the related undescribed species are at present known only from northern Thailand; the latter two probably also occur across the border in Myanmar.

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LITERATURE CITED

- Bristowe, W.S. 1933. The liphistiid spiders. With an appendix on their internal anatomy by J. Milot. Proc. Zool. Soc. London, 1932:1015–1057.
- Bristowe, W.S. 1975. An interesting spider found in Thailand. Nat. Hist. Bull. Siam Soc., 26:166–167.
- Bristowe, W.S. 1976. A contribution to the knowledge of liphistiid spiders. J. Zool., London, 178: 1–6.
- Endo, A. 1980a. The behaviour of a miltogrammine fly *Metopia sauteri* (Townsend) (Diptera, Sarcophagidae) cleptoparasitizing on a spider wasp *Episyron arrogans* (Smith) (Hymenoptera, Pompilidae). Kontyû, 48(4):445–457.

- Endo, A. 1980b. On the host-cleptoparasite relationship between the spider wasp *Episyron arrogans* (Smith) (Hymenoptera, Pompilidae) and the miltogrammine fly *Metopia sauteri* (Townsend) (Diptera, Sarcophagidae). Japanese J. Ecol., 30(2):117–132. (in Japanese with English summary)
- Evans, H.E. 1970. Ecological-behavioral studies of the wasps of Jackson Hole, Wyoming. Bull. Mus. Comp. Zool., 140(7):451–511.
- Haupt, J. 1979. Lebensweise und Sexualverhalten der mesothelen Spinne *Heptathela nishihirai* n. sp. (Araneae, Liphistiidae). Zool. Anz., 202(5/6): 348–374.
- Pape, T. 1986a. A revision of Oriental and eastern Palaearctic species of *Metopia* Meigen (Diptera: Sarcophagidae). Stuttgarter Beitr. Naturk. A: Biol., 395:1–8.
- Pape, T. 1986b. Afrotropical species of *Metopia* (Insecta, Diptera, Sarcophagidae). Steenstrupia, 124(4):73–84.
- Pape, T. 1987. Revision of Neotropical *Metopia* Meigen (Diptera: Sarcophagidae). Syst. Entomol., 12:81–101.
- Pape, T. 1996. Catalogue of the Sarcophagidae of the world (Insecta: Diptera). Mem. Entomol., International, 8:1–558.
- Platnick, N.I. & W.C. Sedgwick. 1984. A revision of the spider genus *Liphistius* (Araneae, Mesothelae). American Mus. Novit., 2781:1–31.
- Price, P.W. 1980. The evolutionary biology of parasites. Princeton Univ. Press, Princeton, New Jersey. xi + 237 pp.
- Schwendinger, P.J. 1990. On the spider genus *Liphistius* (Araneae: Mesothelae) in Thailand and Burma. Zool. Scripta, 19(3):331–351.
- Schwendinger, P.J. 1998. Five new *Liphistius* species (Araneae, Mesothelae) from Thailand. Zool. Scripta, 27(1):17–30.
- Sedgwick, W.C. & N.I. Platnick. 1987. A new species of *Liphistius* (Araneae, Mesothelae) from Johore, Malaysia. Malayan Nature J., 41:361–363.
- Spofford, M.G. & F.E. Kurczewski. 1990. Comparative larvipositional behaviours and cleptoparasitic frequencies of Nearctic species of Miltogrammini (Diptera: Sarcophagidae). J. Nat. Hist., 24:731–755.
- Spofford, M.G., F.E. Kurczewski & W.L. Downes, Jr. 1989. Nearctic species of Miltogrammini (Diptera: Sarcophagidae) associated with species of Aculeata (Hymenoptera: Vespoidea, Pompiloidea, Sphecoidea, Apoidea). J. Kansas Entomol. Soc., 62(2):254–267.
- Yoshikura, M. 1954. Embryological studies on the liphistiid spider, *Heptathela kimurai*. Kumamoto J. Sci. B, 1954:41–48.

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